

STATE OF CALIFORNIA

Specification for Profilable Thermoplastic Traffic Striping Material, White and Yellow

1.0 SCOPE

This specification covers a reflectorized thermoplastic pavement striping material that is applied to Portland cement concrete or asphalt concrete road surfaces in a molten state by a mechanical applicator. Immediately after application to the pavement, glass beads are applied and a profiled surface is imparted to the hot thermoplastic stripe using various mechanical means. Upon cooling to normal pavement temperatures this produces an adherent reflectorized stripe with a surface profile matching the required dimensions, which is capable of resisting deformation by traffic.

2.0 APPLICABLE SPECIFICATIONS

The following specifications, test methods and standards in effect on the opening date of the Invitation for Bid form a part of this specification where referenced.

State of California Specification Designation: 8010-41G-99, Quality Assurance Requirements for Protective Coatings.

California Test Method Designation: No. 423, latest revision.

California Test Method Designation: No. 660, latest revision.

California Department of Transportation, Standard Specifications, July 1995.

Federal Standard Designation: No. 595b, color #33538

American Association of State Highway and Transportation Officials,
AASHTO Designation: M 247, AASHTO Designation: T 250

American Society for Testing and Materials, ASTM Designation: G 53, ASTM Designation: E 28, ASTM Designation: D 2794.

Commission International de l'Eclairage (C.I.E.) 1931 Chromaticity Diagram.

California Code of Regulations Designation: Title 22.

3.0 REQUIREMENTS

3.1 Composition:

The thermoplastic material shall be composed of 100% solids. The binder shall consist of synthetic hydrocarbon thermoplastic resin and shall be homogeneously blended with all necessary pigments, fillers, glass beads and additives to produce a traffic striping material to meet the requirements as specified herein.

When tested according to California Code of Regulations, Title 22, Division 4.5, Chapter 11, Article 5, section 66261.126 - Appendix II (California Waste Extraction Test), the yellow materials shall have an extractable lead content of less than 0.3 mg per liter.

3.2 Form:

The thermoplastic material shall be supplied in either block or granular form as requested in the purchase order.

3.3 Application Type:

The thermoplastic material shall be formulated for profiled application and shall have adequate viscosity and thixotrophy to retain its profiled height and shape and not flow or flatten while cooling or when bearing traffic.

3.4 Characteristics of the Finished Thermoplastic:

Use **California Test Method Designation: No. 423 (CTM 423)** unless otherwise specified.

	<u>White</u>	<u>Yellow</u>
3.4.1 Glass Beads, intermixed, AASHTO Designation: M 247 Type I, coated with an acrylic-functional silane adhesion coating (i.e. AC-07 or equal), percent by weight, minimum.	35	35
3.4.2 Binder, percent by weight, minimum.	18	18
3.4.3 Density, g/ml, maximum.	2.15	2.15
3.4.4 Ring and Ball Softening Point, minimum CTM 423 (Part VI), ASTM Designation: E 28.	115°C	115°C
3.4.5 Perform the remaining tests on the material after 4 hours heating with stirring at 204°C ± 2°C, which includes 1 hour for meltdown and temperature stabilization.		
3.4.5.1 Tensile Bond Strength to an unprimed abrasive blasted Portland cement concrete brick, 3.2 mm thick film draw down at 204°C, tested at 25°C ± 2°C, Mpa, minimum, CTM 423 (Part VII).	1.24 MPa	1.24 MPa
3.4.5.2 Brookfield Thermosel Viscosity, Spindle SC4-27, 2.5 rpm at 204°C, Pa•s, minimum, CTM 423 (Part VIII).	30	30

	<u>White</u>	<u>Yellow</u>
<p>3.4.5.3 Viscosity Shear Ratio, minimum. Use CTM 423 (Part VIII) as in 3.4.5.2 above except determine Brookfield Thermosel Viscosity at both 0.5 rpm and 2.5 rpm (at 204°C). Calculate Viscosity Shear Ratio as:</p> $\text{Viscosity Shear Ratio} = \frac{\text{viscosity at 0.5 rpm}}{\text{viscosity at 2.5 rpm}}$	3	3
<p>3.4.5.4 Impact Resistance, 3.2 mm thick film draw down at 204°C on an unprimed abrasive blasted Portland cement concrete brick, male indenter 15.9 mm diameter, no female die. Test at 25°C ± 2°C, kilogram force•meter, with no cracks or bond loss, minimum CTM 423 (Part IX), ASTM Designation D 2794.</p>	0.58	0.58
<p>3.4.5.5 Daylight Luminous Reflectance CTM 423 (Part XI).</p>	80 Minimum	45 - 59
<p>3.4.5.6 Color, yellow, shall match Federal Standard Designation: No. 595b, color #33538 and shall lie within the following chromaticity limits when plotted on a C.I.E. 1931 Chromaticity diagram; HUE = 580.0 to 583.5 nanometers, MINIMUM COLOR SATURATION LIMIT x = 0.7050 - 0.5000y, BRIGHTNESS Y = 45 to 59, Measurement conditions = 2°/illuminant "C" when tested according to California Test Method Designation: No. 660.</p>	---	Pass
<p>3.4.5.7 Yellowness Index, calculated as YI = 100(A-B)/G, maximum CTM 423 (Part XI).</p>	12	---

	<u>White</u>	<u>Yellow</u>
3.4.5.8 Ultraviolet Light and Condensation Exposure, 300 hours total: alternate 4 hours UV exposure at 60°C, followed by 4 hours condensate exposure at 40°C. Type FS-40 (UV-B) bulbs are used at an irradiance level of 0.47 watts per square meter at 310 nm., as measured at the sample surface during the UV cycle. CTM 423 (Part XIII), ASTM Designation: G 53.		
White - Yellowness Index, maximum	20	---
Yellow - Must meet chromaticity limits as specified in 3.4.5.6	---	Pass
3.4.5.9 Hardness, Shore A-2 Durometer with 2 kg weight, at 46.1°C, CTM 423 (Part XII).	20 - 75	20 - 75

3.5 **Other Requirements:**

3.5.1 Applicability

The molten thermoplastic material shall be readily applied at temperatures between 193°C - 210°C. Upon application to the pavement, the thermoplastic material shall be sufficiently tack-free to carry traffic; in not more than 2 minutes when the pavement surface temperature is 16°C, and in not more than 10 minutes when the pavement surface temperature is 54°C. Applying the material when pavement temperatures are outside of the 16°C to 54°C range is not recommended.

3.5.2 Slump Test

3.5.2.1 Purpose:

The ability of the applied profiled material to resist leveling while hot is described below.

3.5.2.2 Summary:

Using a specialized slump test die box (Figure 4), a stripe of the molten thermoplastic material is extruded onto a concrete brick leaving profiled grooves in the thermoplastic surface. The widths of these grooves are measured after the material has cooled to determine if excessive leveling has occurred.

3.5.2.3 Apparatus:

A die box shall be formed that is enclosed on three sides utilizing 3.2 mm X 50.8 mm flat steel stock (Figure 4). The parts shall be welded together to form a screed box. One edge of this box shall have gaps (openings) milled as shown in Figure 4. These gaps will produce a profiled thermoplastic line to be extruded when the die box is moved across the concrete brick. The rear of the die shall be joined together using a piece of 12.7 mm diameter round steel stock. A handle can be affixed in order to move the die box (Figure 4). A forced air oven maintained at $204^{\circ}\text{C} \pm 2^{\circ}\text{C}$, a ladle and a abrasive-blasted concrete brick as described in California Test Method Designation No. 423 (Part VII) will also be needed. Measurement of the width of the profiled groove can be done using a caliper.

3.5.2.4 Procedure:

The specialized die box (Figure 4) is placed in a $204^{\circ}\text{C} \pm 2^{\circ}\text{C}$ oven and allowed to equilibrate to oven temperature. The abrasive-blasted concrete brick is placed on a sturdy workbench and allowed to reach $25^{\circ}\text{C} \pm 2^{\circ}\text{C}$. The melted thermoplastic sample from the tests in section 3.4.5 is maintained at 204°C for 2 to 4 hours with stirring from the time the sample becomes completely melted.

Working quickly to avoid excessive cooling, remove the hot die box from the oven and place it on one end of the concrete brick (Figure 1). Quickly ladle approximately 350 gm of the hot thermoplastic sample into the die box reservoir (Figure 1). Draw the die box along the 178 mm length of the concrete brick in a smooth motion requiring approximately 3 seconds (Figure 2). Continue drawing the die box along and off the edge of the concrete brick (Figure 2). This should form a profiled stripe of thermoplastic on the face of the brick. Allow the thermoplastic to cool to room temperature and measure the width of the profiled grooves in the thermoplastic stripe using a caliper to determine the distance between the vertical faces of each groove at the bottom of the groove (Figure 3). Measure this distance at 3 different places in each groove of the profiled stripe. The average distance between the vertical faces of a passing sample shall be greater than 5.00 mm.

3.5.3 Compression Test

3.5.3.1 Purpose:

The ability of the thermoplastic material to resist deformation, while under a load and at typical hot pavement temperatures, is described below.

3.5.3.2 Summary:

The hot thermoplastic material is cast in a rectangular mold and allowed to cool. The sample is removed from the mold and placed in an oven with a static load on top of the sample. After 4 hours the deformation of the sample is measured.

3.5.3.3 Apparatus:

A rectangular steel form shall be fabricated from 15.9 mm square bar stock steel (Figure 5). The form shall be assembled at the corners with socket head cap screws for easy disassembly. The inside dimensions of the form shall be 40.6 mm X 99.1 mm. Also required are; a standard 2" X 3.5" X 8" red clay construction brick weighing 2500 gms \pm 200 gms, a 200 mm X 200 mm piece of 6 mm thick Masonite board, a forced air oven maintained at 85°C \pm 2°C, silicone mold release spray and silicone release paper.

3.5.3.4 Procedure:

Assemble the mold and spray the interior surfaces with the mold release spray. Center the mold on the Masonite hardboard and place on a level surface. Fill the mold slightly more than level full with hot thermoplastic material heated to 204°C \pm 2°C in accordance with section 3.4.5. Strike off the excess thermoplastic to form a flat surface on the top of the sample. Allow the sample to cool for at least 4 hours before removing the mold. Leave the molded sample on the Masonite board. Measure the surface area of the top face of the rectangular thermoplastic sample. Cover the top of the sample with a piece of silicone release paper slightly larger than the sample itself. Place the large face of the brick squarely on top of the molded sample, centering the brick on top of the sample (Figure 6). Place the Masonite board, thermoplastic sample, silicone release paper and brick in an 85°C forced air oven for 4 hours. At the end of 4 hours remove the sample from the oven and remove the brick from the sample. Allow the sample to cool to room temperature and measure the surface area of the top face of the thermoplastic sample (Figure 7). The surface area shall increase by no more than 10% above the initial surface area.

3.6 **Workmanship:**

The binder, pigments, glass beads, fillers and additives shall be homogeneously blended. The material shall be free from all; dirt, foreign matter, and other deleterious substances, and shall be of such composition that it will not bleed, stain, or discolor when applied to pavements.

The thermoplastic material shall not emit fumes that are toxic or injurious to persons or property when it is heated to application temperature. The material shall not emit excessive smoke during heating or application.

3.7 **Shelf Life:**

The material shall maintain the requirements of this specification for a minimum period of one year. Any materials failing to do so shall be replaced at the expense of the manufacturer.

3.8 Air Pollution Compliance:

This material shall comply with all applicable air pollution control rules and regulations.

3.9 Material Safety Data Sheets:

Material Safety Data Sheets shall be provided by the manufacturer to include health hazard information on the material when it is heated to application temperature.

4.0 QUALITY ASSURANCE PROVISIONS

4.1 Inspections:

This material shall be sampled and inspected in accordance with State of California Specification Designation: 8010-XXX-99, or as otherwise deemed necessary. State Specification Designation: 8010-XXX-99 is on file and obtainable at the Department of General Services, Division of Procurement.

The minimum size batch of thermoplastic traffic striping material sampled and tested shall not be less than 900 kg unless the total order is less than this amount.

All thermoplastic material intended for use by the State of California must be sampled and approved by the Office of Materials and Foundations before shipment. Manufacturers within the State of California must contact the Sacramento, Emeryville, or Los Angeles Inspection Office for sampling procedures.

Manufacturers outside the State of California must submit the following information, along with two representative 6 kg samples of each lot, before shipment:

1. State Specification number (PTH 499A)
2. Color; white and/or yellow, and kg of each
3. Form; block or granular
4. Binder Type (hydrocarbon or alkyd)
5. Exact destination address of shipment
6. Number and identification of batches comprising shipment
7. Date of manufacture
8. Purchase order or contract number

The above information is to be sent to:

Office of Materials and Foundations
Structural Materials Branch, Inspection Section
5900 Folsom Boulevard
Sacramento, CA 95819

On delivery, the thermoplastic may be sampled again for compliance to specification. Material not meeting the specification shall be removed and replaced by the manufacturer at their expense, including all costs for handling, testing, and shipping.

4.2 Testing:

All tests shall be performed according to the specified test methods, latest revision. Qualitative and quantitative analysis may also be performed by other methods of analysis, at the option of the California Department of Transportation.

5.0 PREPARATION FOR DELIVERY

5.1 Packaging:

5.1.1 Block Form:

The thermoplastic material shall be packaged in suitable containers to which it will not adhere nor interact during shipment or storage. The blocks of cast thermoplastic material shall be approximately 900 by 300 by 50 mm and shall weigh approximately 22.7 kg.

5.1.2 Granular Form:

The thermoplastic material shall be packaged in meltable bags which are compatible with the thermoplastic and which weigh approximately 22.7 kg when filled. The containers must have sufficient strength and be properly sealed to prevent breakage and leakage during normal handling.

5.2 Markings:

Each container label shall include: State Specification Designation Number, color, type of binder, manufacturer's name and address, date of manufacturer, and batch number. All markings on containers shall be legible and permanent. Markings shall not smear or rub off container. Containers failing to meet marking requirements will not be accepted.

The containers and labeling shall meet all applicable US Department of Transportation and Interstate Commerce Commission regulations. Concerning the content, each container shall be labeled with such warnings or precautions as are required by local, state, and federal laws and requirements.

6.0 NOTES

6.1 Certificates of Compliance:

The manufacturer of thermoplastic materials shall furnish the Engineer with a Certificate of Compliance in conformance with the provisions of the California Department of Transportation Standard Specifications, July 1995, section 6-1.07, "Certificate of Compliance." The Certificate shall also include a list, by title and section, of all applicable state and federal packaging and labeling laws and a statement that all requirements have been met.

Certificates of Compliance shall be sent to:

Office of Materials and Foundations
Structural Materials Branch, Inspection Section
5900 Folsom Boulevard
Sacramento, CA 95819

6.2 Patents:

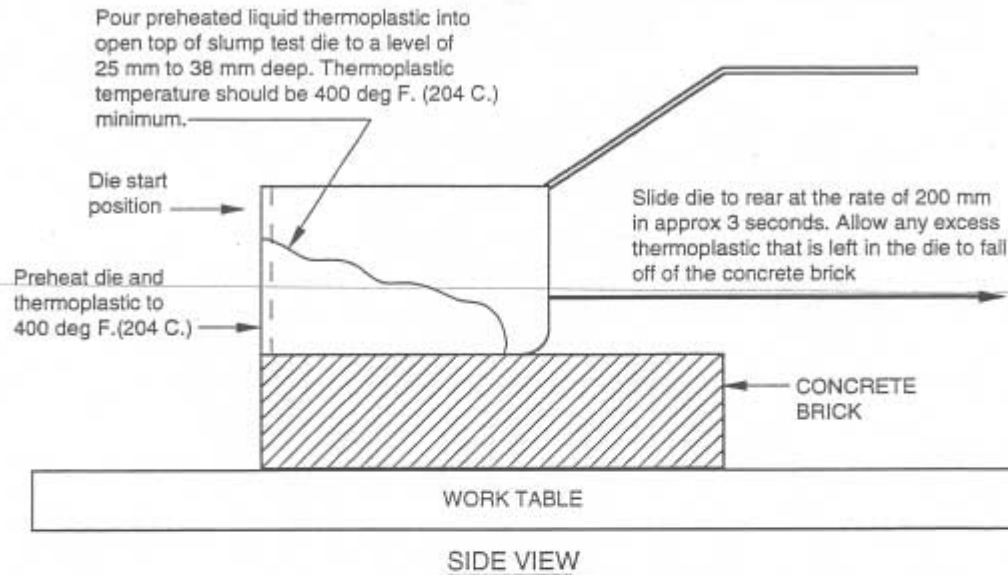
The Contractor shall assume all costs arising from the use of patented; materials, equipment, devices or processes used on or incorporated in the work, and further agrees to indemnify and save harmless the State of California and its duly authorized representatives from all suits at law or action of every nature for or on account of the use of any patented; materials, equipment, devices or processes.

DEPARTMENT OF TRANSPORTATION
APRIL, 1999

**PROFIED THERMOPLASTIC
SLUMP TEST PROCEDURE**

(N.T.S.)

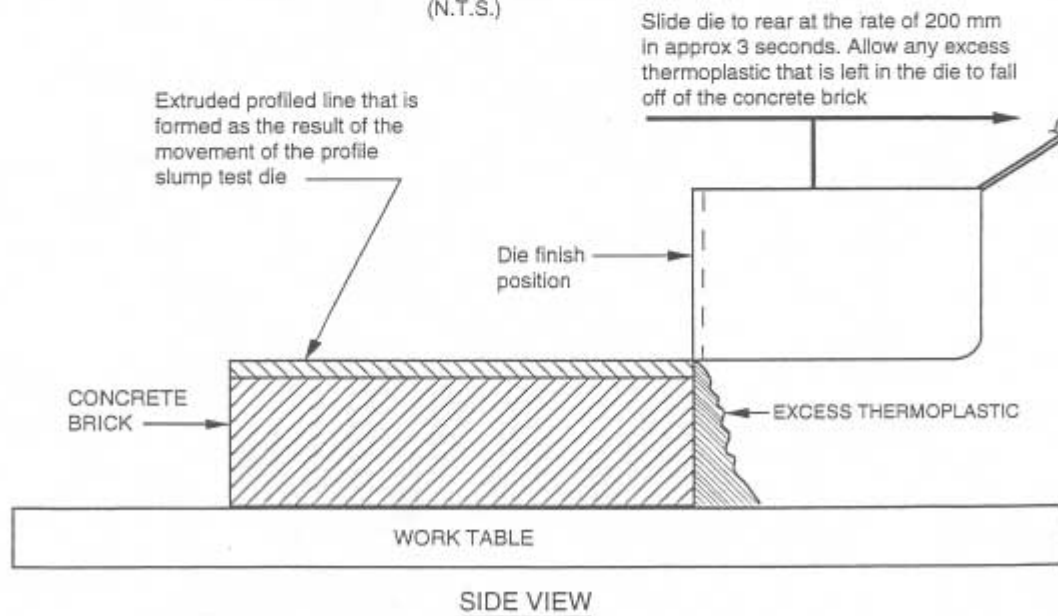
FIG. 1



**PROFIED THERMOPLASTIC
SLUMP TEST PROCEDURE**

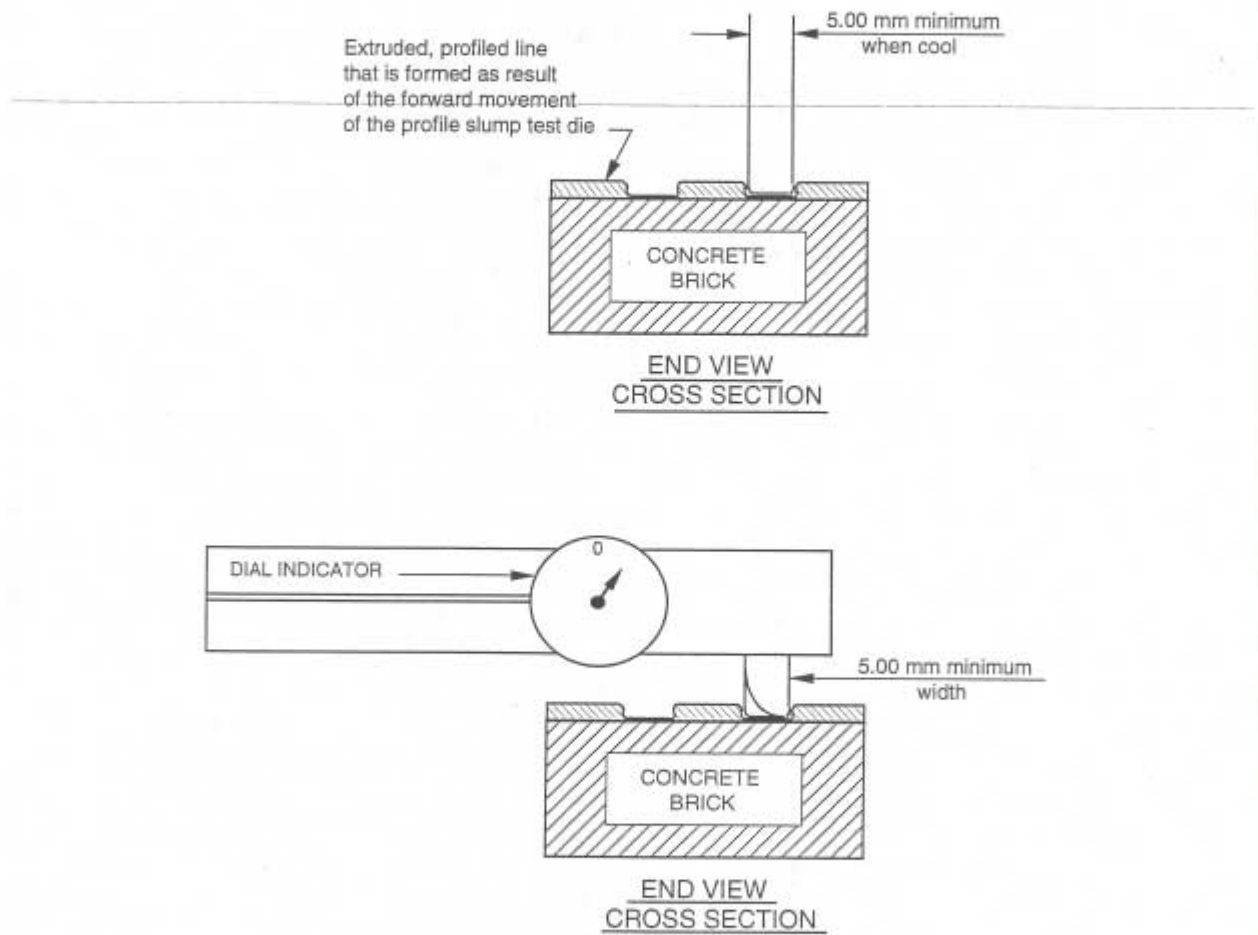
(N.T.S.)

FIG. 2



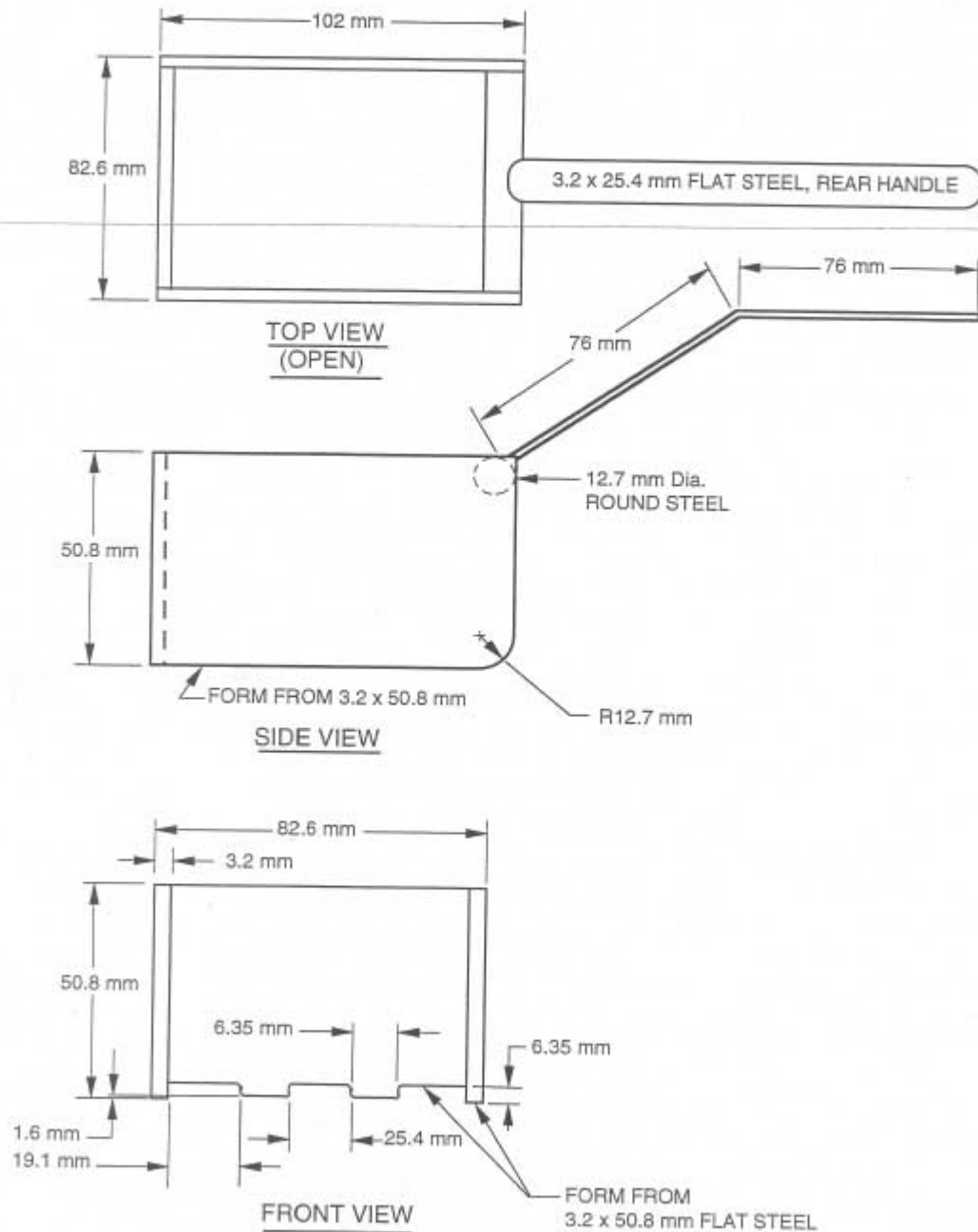
**PROFIBLE THERMOPLASTIC
SLUMP TEST PROCEDURE**
(N.T.S.)

FIG. 3



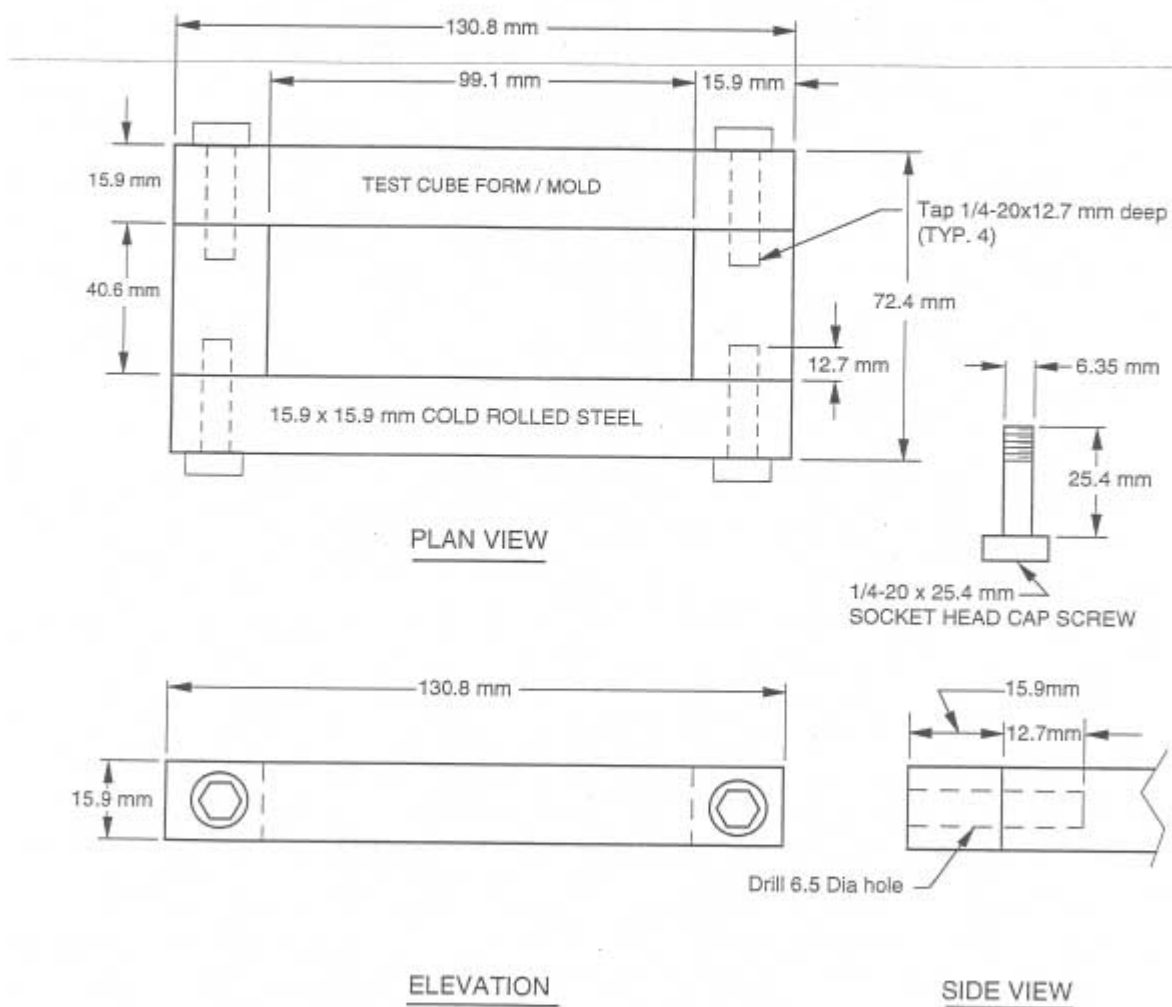
**PROFIED THERMOPLASTIC
SLUMP TEST PROCEDURE**
(N.T.S.)

FIG. 4



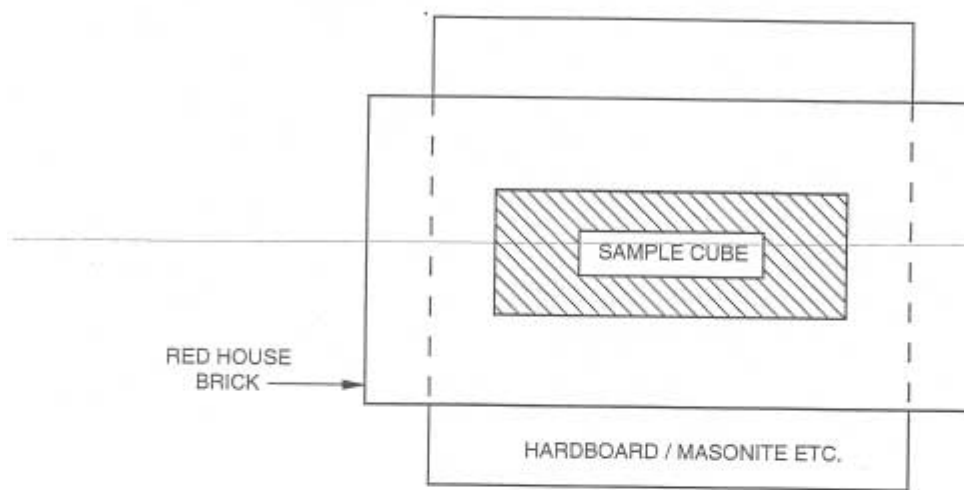
**PROFIED THERMOPLASTIC
 COMPRESSION TEST PROCEDURE**
 (N.T.S.)

FIG. 5

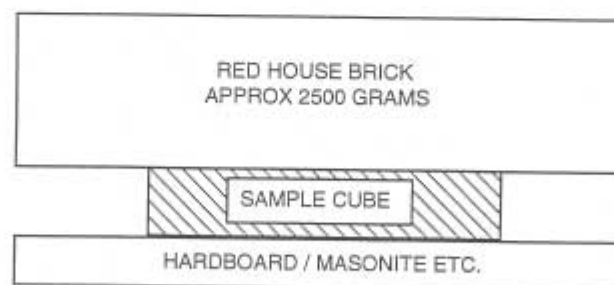


**PROFILED THERMOPLASTIC
COMPRESSION TEST PROCEDURE**
(N.T.S.)

FIG. 6



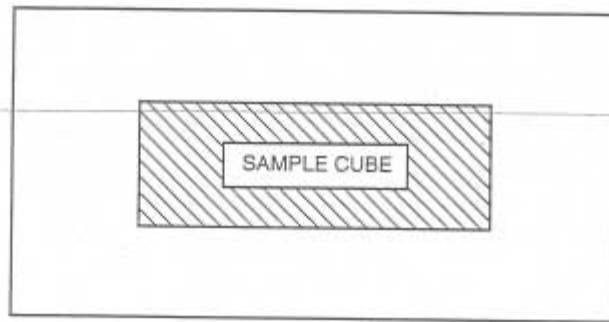
PLAN VIEW



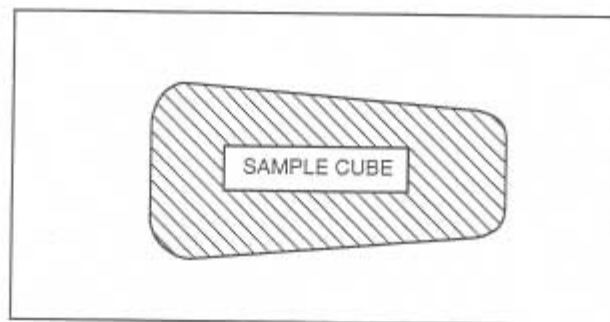
SIDE VIEW

**PROFIED THERMOPLASTIC
COMPRESSION TEST PROCEDURE**
(N.T.S.)

FIG. 7



AFTER TEST-TYPICAL PASS



AFTER TEST-TYPICAL FAIL

